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4	139	174/52.2.ccls. and "IC"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/04/25 11:36
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-	2	microcircuit and stacking and encapsulating and 174/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/04/25 10:12

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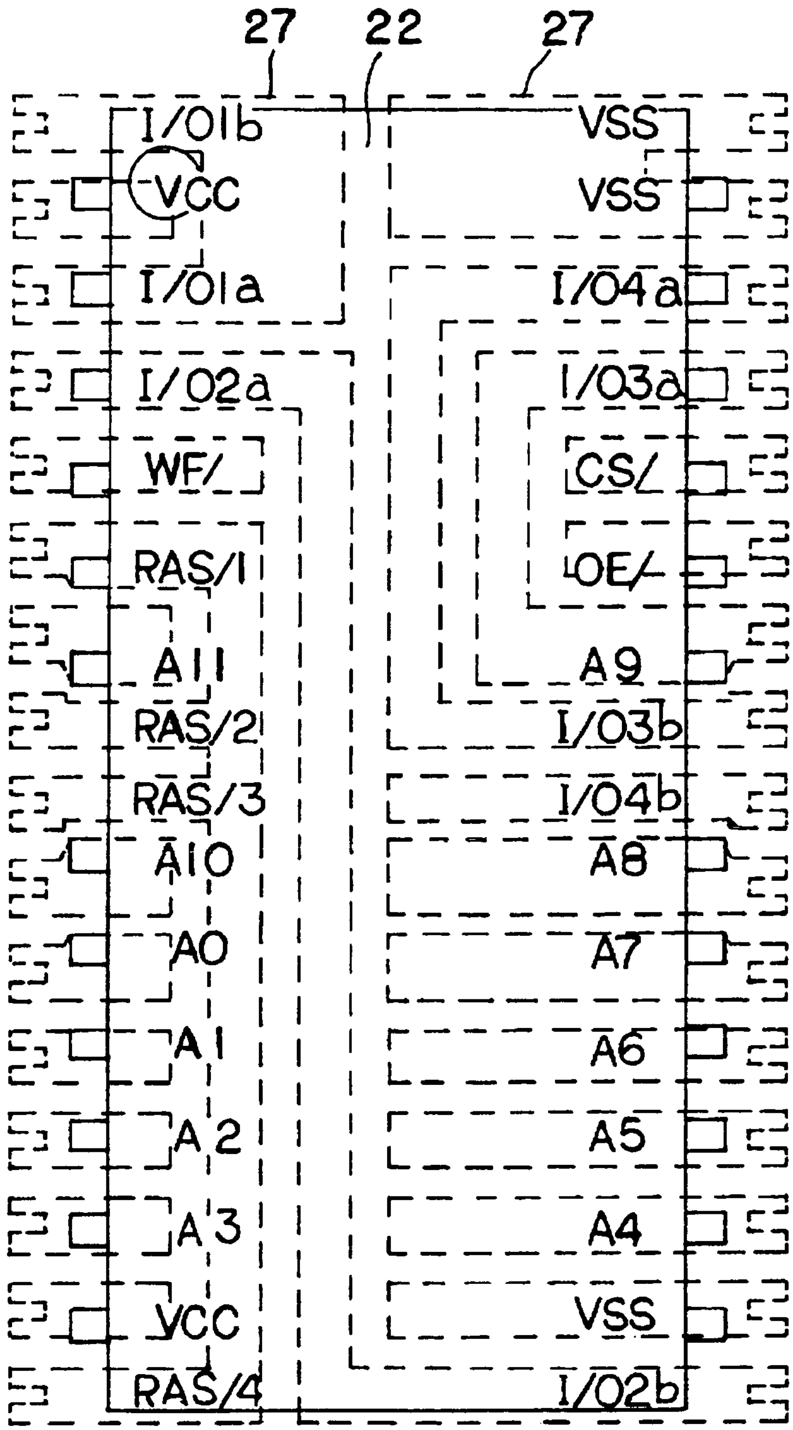
27
22
27
I/O1b
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A0
A1
A2
A3
VCC
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VSS
VSS
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I/O3a
CS/
OE/
A9
I/O3b
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A8
A7
A6
A5
A4
VSS
I/O2b

Fig. 24

DOCUMENT-IDENTIFIER: US 4933744 A
TITLE: Resin encapsulated electronic devices

---------- KWIC ---------

BSPR:
This invention relates to resin encapsulated electronic devices including, for example, semiconductor devices such as diodes, trannsistors, **IC,** LSI, etc., and other electronic devices including resistors, capacitors, etc., and more particularly the invention relates to improved resin encapsulated electronic devices.

BSPR:
On the other hand, efforts are being made for achieving higher density and greater scale of elements for enhancing the integration capacity of semiconductor devices such as **IC** and LSI while, conversely, there is seen an increasing tendency toward miniaturization of the package. However, in the case of electronic devices comprising large-sized elements encapsulated with a conventional resin, cracks tend to develop in the element surface. This tendency is boosted if the package is thinned, and finally cracks are formed even in the encapsulation resin layer. Similar trend toward larger size of the semiconductor elements is seen in such electronic devices as transistors and thyristors with improvement of high voltage resistance, and the same problem of cracks is encountered in these devices, too. Thus, the conventional electronic devices having large-sized elements encapsulated with resin had a problem of poor reliability.

DEPR:
The electronic devices to be resin encapsulated according

to this invention also include resistors, capacitors and the like. Typically, they are the semi-conductor elements such as diodes, transistors, **IC** (integrated circuits) and LSI (large-scale integrated circuits). Particularly when such elements measure, for example, about 0.5 mm in thickness and more than 2 mm in the maximum length, that is, when the maximum lateral length is four times or more as large as the thickness, the effect of this invention is most appreciated. If the maximum length of the element is less than 2 mm, cracking of the element presents no specific problem but on the other hand such element proves incapable of enhancing the integration capacity of **IC** or LSI or meeting the requirement for high voltage resistance of transistors or thyristors. The "maximum length" of the element means the diameter when the major surface (so-called flat plane) of the element is circular, the longer diameter when the major surface (so-called flat plane) of the element is oval, the length of the longest diagonal when the major surface (so-called flat plane) of the element is polygonal, and one side of the longest length when the major surface (so-called flat plane) of the element is square or rectangular.

DEPR:
As described above, the present invention can minimize the stress given by the encapsulating resin and is therefore advantageously applicable to the electronic devices in which the stress is localized due to a so-called flat or plate-like configuration of the elements and which have poor mechanical strength. Examples of such electronic devices are the large-size **IC** or LSI in which the maximum length of the elements is over 2 mm, or the electronic devices manufactured by using the ceramic substrate

thick-film techniques.
Particularly in power **IC** (high voltage resistant **IC**) or an electronic device made by using the ceramic substrate thick-film techniques, in case one side alone of the element is encapsulated with the resin composition of this invention for enhancing the heat dissipation efficiency, it is possible to prevent warp of the heat radiating plates and ceramic substrate by dint of said encapsulating resin and to also prevent break of the element due to such warp.
Further, in the case of a device which includes, for example, ferrite core where the magnetic force may be varied by the stress, application of the resin encapsulation according to this invention can diminish the stress to prevent otherwise possible change of magnetic force in the ferrite core. The present invention also finds a very effective application to the devices wherein the form after encapsulated with the resin has a so-called flat or plate-like configuration as seen such as LSI, where the elements are most likely to suffer damage by stress.

DEPR:
In the drawings, reference numeral 1 designates a flat-shaped semiconductor element having a p-n junction and made of silicon, germanium or the like material, such as an **IC,** LSI, transistor or thyristor, said element measuring 0.1-1 mm in thickness and 2 mm or more in length of one side. Numeral 2 indicates an internal fine connector wire connecting the semiconductor element 1 and the outer lead 4, said wire being made of Au, Al or the like material.
Numeral 3 is a metallic conductor which is a sort of internal connecting conductor fabricated by baking a Pd-Ag conductor on an Al.sub.2 O.sub.3 insulating plate 5 with a vitreous material. The outer lead 4 may be formed

from Cu or "Kovar" a registered trademark of Westinghouse Electric Corporation
for a Fe-based alloy.

DEPR:
Numeral 4A and 4B each denotes a Cu foil which is a kind of conductor. In the
case of the Cu foil 4B, it is formed on an insulating film 8 made of polyimide,
polyester or the like materal or on the Al.sub.2 O.sub.3 insulating plate 5.
Instead of the Al.sub.2 O.sub.3 insulating plate 5, there may be used a
metallic sheet whose surface has been subjected to an oxidation treatment or
resin coating. The Cu foil 4A is effective for heat dissipation. Also in the
drawings, numeral 6 refers to a resin for encapsulating the semiconductor
element 1, and in this invention, the rubber-like particles are dispersed in
this encapsulating resin 6. As a modification, only the portion close to the
semiconductor element 1 may be encapsulated with a resin having the rubber-like
particles dispersed therein, with the portion indicated by 6A in the drawing
being encapsulated with a different resin. It is of course possible to use the
same resin composition for the portions indicated by 6 and 6A in the drawing.
Numeral 7 denotes an insulator case made from epoxy resin, polyphenylene
sulfide or other like material. 2A indicates metal balls or solder. FIG. 11
shows a sectional view of a hybrid **IC,** wherein numeral 9 refers to a capacitor
and numeral 10 a resistor.

DEPR:
The molding conditions were 180.degree. C. and 3 minutes, and the molding
operation was followed by post curing at 150.degree. C. for 15 hours. The
heat cycle test was conducted on the MOS type **IC** elements of FIG. 3 (10
specimens for each group) made from each said molding composition under the

same conditions as in the composite acceleration test of Example 1. The clamping stress measuring test was conducted by using a steel-made cylinder having an outer diameter of 10 mm and a thickness of 0.3 mm, with the inner diameter of the outer mold being 50 mm, under the same conditions as in the aforesaid stress determination test.

DEPR:
The above ingredients (1) to (5) were mixed in a vacuum mixing and **grinding** machine for 20 minutes, and after addign another ingredient (6), they were further mixed up for 5 minutes. Then the composition was potted into a 5 mm.times.5 mm MOS type LSI silicone element shown in FIG. 1 in the same manner as Example 1 and then cured at 80.degree. C. for 15 hours and at 180.degree. C. for additional 15 hours to obtain a resin encapsulated semiconductor device. The rubber particles had a particle size of 2-5 .mu.m and the rubber content was approximately 12% by volume.

CCXR:
174/52.2